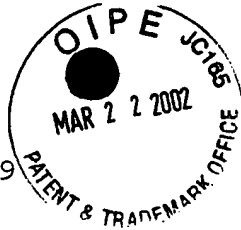


differences between the translation of the originally-filed specification and the enclosed

Substitute Specification is also enclosed herewith.



Description

Method of monitoring or installing new program codes in an industrial installation

5

The invention relates to a method of monitoring an industrial installation or installing new program codes in an industrial installation.

10 For the purpose of remote monitoring of industrial installations, as is known, appropriate process logs and log files from their automation systems are evaluated. Decisions, for example as to how warning messages are to be reacted to, can as a result be made only with a
15 relatively large time delay, since the evaluation of the information is basically carried out offline. Special problems are caused, for example, by the fact that installations and evaluation center can be located in different time zones, or that appropriately qualified
20 personnel are not available 24 hours per day. It is therefore possible that an evaluation is carried out with some hours delay, and the log files needed for the evaluation have already been overwritten. In addition, as a result of the random evaluation, it is not possible to
25 react to all fault messages, since not all the information is transmitted. For this reason, complete and comprehensive remote monitoring of an industrial installation is possible only to a restricted extent. Accordingly, it is an object of the invention to
30 permit improved monitoring of a large industrial plant.

According to the invention, the object is achieved by a method as claimed in claim 1. Here, monitoring of an industrial installation, in particular an installation in
35 the raw materials industry, is carried out by means of a

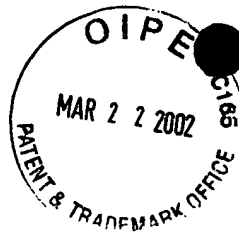
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mobile program code, which monitors

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the industrial installation, in particular the
installation in the raw materials industry, automatically
for faults or special events, in the event of a fault or
a special event, the information needed to evaluate the
5 fault or the special

event being transmitted by means of the mobile program code or a further mobile program code to an evaluation center separated physically from the industrial installation, in particular the installation in the raw materials industry. Here, special events are to be understood as violations of limiting values or trends of particular significance. Special events can in addition be tolerance deviation of process data (strip profile faults, temperature faults and so on) or special features in the convergence behavior in the adaptation of models. In this way, much faster and more comprehensive evaluation of faults, limiting value violations and so on is possible. It is further of particular advantage to carry out the recognition of trends of looming faults by means of the information determined by the mobile program code. This permits, for example, preventative maintenance of a corresponding installation.

In an advantageous refinement of the invention, the mobile program code forms and dispatches new mobile program code, the new mobile program code monitoring parts of the industrial installation, in particular the installation in the raw materials industry, automatically for faults or special events, in the event of a fault or a special event, the information needed to evaluate the fault or the special event being transmitted directly to the evaluation center or, in particular for further transmission to the evaluation center, to another mobile program code.

For industrial installations, in particular installations in the raw materials industry, it is additionally desirable to improve the installation of program codes, in particular control program codes, for the closed-loop and open-loop control of the industrial installation, in

particular the installation in the raw materials industry, and its subsystem.

According to the invention, this object is achieved by a method as claimed in claim 3. Here, in order to install
5 new control program codes for the closed-loop or open-loop control of an industrial installation, in particular an installation in the raw materials industry, the new control program code being transmitted from a development center to the industrial installation, in particular the
10 installation in the raw materials industry, and being installed and commissioned independently by a mobile program code on the industrial installation, in particular the installation in the raw materials industry. In this case, in an advantageous refinement of
15 the invention, the mobile program code is transmitted from the evaluation center or the development center to the industrial installation, in particular the installation in the raw materials industry.

20 In a further advantageous refinement of the invention, information is transmitted between the evaluation center or the development center and the industrial installation, in particular the installation in the raw materials industry, via ISDN, satellite or Internet.

25 In an advantageous refinement of the invention, the evaluation center is used as a development center.

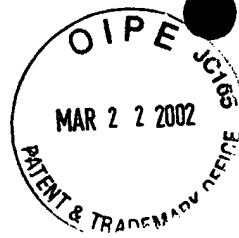
In an advantageous refinement of the invention, the
30 mobile program code is JAVA program code.

In an advantageous refinement of the invention, the mobile program code runs on hardware provided for the open-loop or closed-loop control of the industrial
35 installation, in particular the installation in the raw

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materials industry.



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Further advantages and details emerge from the following description of an exemplary embodiment.

- 5 The FIG shows, in an exemplary configuration, an industrial installation 30, illustrated schematically, with its control

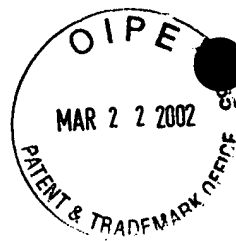
system and its actuators and sensors, without the actual process sequence. The industrial installation 30 has an industrial Ethernet bus 9, which provides a data connection between two identically or differently configured automation devices 5 and 6, an operating computer 4 and a commissioning computer 1. The industrial Ethernet bus 9 is connected to a standard Ethernet bus 8 via a computer 7. An operating computer 2 and a central operating computer 3 are connected to the standard Ethernet bus 8. Via a bus system 23, which is designed as a Profibus, various actuators or sensors 12, 13, 14, 15 are provided with a data connection to the automation device 5. Furthermore, a decentralized peripheral 10 is connected to the automation device 6 via the bus system 23. Via a bus system 24, which is designed as a Profibus, various actuators or sensors 16, 17, 18, 19 are provided with a data connection to the automation device 6. Furthermore, a decentralized peripheral 11 is connected to the automation device 6 via the bus system 24. Via the decentralized peripheral 11, various actuators and sensors 20, 21, 22 can be driven or evaluated via the automation device 6. The operating computers 2, 3, 4, the automatic devices 5, 6, the decentralized peripherals 10, 11, the actuators or sensors 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and the bus systems 8, 9, 23, 24 serve the operation of the industrial installation.

Reference symbol 40 designates an evaluation center that is separated physically from the industrial installation 30 and is advantageously also used as a development center. In an exemplary configuration, the evaluation center 40 has a computer system having, for example, a plurality of computers 41 and 42 coupled via a bus system 43. A communication link 50 provides a data connection between the industrial plant 30 and the evaluation center

40. In this case, this does not have to be a so-called
dedicated line. In an exemplary

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configuration, the industrial plant 30 and the evaluation center 40 have a data connection to each other via the commissioning

computer 1 on the side of the industrial installation 30 and the computer 41 on the side of the evaluation center 40. In order to monitor the industrial installation 30, mobile program code is transmitted from the computer 41 to the commissioning computer 1. By means of the transmitted mobile program code, which runs on the commissioning computer 1, the other components 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 are monitored for faults or special events, such as limiting value violations. For this purpose, the mobile program code operating on the commissioning computer 1 automatically generates further mobile program codes, which are transmitted from the commissioning computer 1 to the automation devices 5, 6, the decentralized peripherals 10 and 11 and to the actuators or sensors 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and, if appropriate, to the operating computers 2, 3, 4. If one of these transmitted mobile program codes detects a fault or a special event, then this mobile program code transmits a communication relating to this fault or the special event and also all the information needed for evaluation to the mobile program code installed on the commissioning computer 1, which sets up the communications link 50 to the computer 41 and then transmits this information to the computer 41. The transmitted information can, for example, be log files which are generated on the basis of warning and error messages. Furthermore, it may be tolerance deviations of process data (for example strip profile faults, temperature faults and so on), adaptation coefficients or coefficients from neural networks and the states of computers (for example memories, hard disk capacity, CPU loading and so on). In addition, provision can be made to register the frequency of warning messages and to evaluate it statistically.

The mobile program code is particularly advantageously implemented in JAVA. This is preferably carried out by following the Aglet concept, as disclosed by D.B. Lange, M.

Oshima: "Programming and Developing JAVA Mobile Agents with Aglets", Edison-Wesley, 1998.

The invention is used particularly advantageously in
5 rolling mills.

Patent claims

1. A method of monitoring an industrial installation,
in particular an installation in the raw materials
5 industry, by means of a mobile program code, which
monitors the industrial installation, in particular
the installation in the raw materials industry,
automatically for faults or special events, in the
event of a fault or a special event, the information
10 needed to evaluate the fault or the special event
being transmitted by means of the mobile program
code or a further mobile program code to an
evaluation center separated physically from the
industrial installation, in particular the
15 installation in the raw materials industry.
2. The method as claimed in claim 1, characterized in
that the mobile program code forms new mobile
program code and dispatches it in the industrial
20 installation, in particular the installation in the
raw materials industry, the new mobile program code
monitoring parts of the industrial installation, in
particular the installation in the raw materials
industry, automatically for faults or special
25 events, in the event of a fault or a special event,
the information needed to evaluate the fault or the
special event being transmitted directly to the
evaluation center or, in particular for further
transmission to the evaluation center, to another
30 mobile program code.
3. A method of installing new control program codes for
the closed-loop or open-loop control of an
industrial installation, in particular an install-
35 ation in the raw materials industry, the new control

program code being transmitted from a development
center to the industrial installation,

in particular the installation in the raw materials industry, and being installed and commissioned independently by a mobile program code on the industrial installation, in particular the installation in the raw
5 materials industry.

4. The method as claimed in claim 1, 2 or 3, characterized in that the mobile program code is transmitted from the evaluation center or the development center to the industrial installation, in particular the installation in the raw materials industry.
5. The method as claimed in claim 1, 2, 3 or 4, characterized in that information is transmitted between the evaluation center or the development center and the industrial installation, in particular the installation in the raw materials industry, via ISDN, satellite or Internet.
6. The method as claimed in claim 1, 2, 3, 4 or 5, characterized in that the evaluation center is used as a development center.
7. The method as claimed in one of the preceding claims, characterized in that the mobile program code is JAVA program code.
8. The method as claimed in one of the preceding claims, characterized in that the mobile program code runs on hardware provided for the open-loop or closed-loop control of the industrial installation, in particular the installation in the raw materials industry.



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Description

Method of monitoring or installing new program codes in an industrial installation

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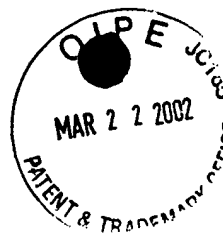
The invention relates to a method of monitoring an industrial installation or installing new program codes in an industrial installation.

- 10 For the purpose of remote monitoring of industrial installations as is known, appropriate process logs and log files from their automation systems are evaluated. Decisions, for example as to how warning messages are to be reacted to, can as a result be made only with a
- 15 relatively large time delay, since the evaluation of the information is basically carried out offline. Special problems are caused, for example, by the fact that installations and evaluation center can be located in different time zones, or that appropriately qualified
- 20 personnel are not available 24 hours per day. It is therefore possible that an evaluation is carried out with some hours delay, and the log files needed for the evaluation have already been overwritten. In addition, as a result of the random evaluation, it is is not possible
- 25 to react to all fault messages, since not all the information is transmitted. For this reason, complete and comprehensive remote monitoring of an industrial installation is possible is possible only to a restricted extent. For industrial installation, in particular
- 30 installations in the raw materials industry, it is additionally desirable to improve the installation of program codes, in particular control program codes, for the closed-loop and open-loop control of the industrial

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installation, in particular the installation in the raw materials industry, and its subsystem. Accordingly, it is an object of the



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invention to permit improved monitoring of a large industrial plant.

5 According to the invention, the object is achieved by a method as claimed in claim 1. In this case, a mobile program code for the closed-loop or open-loop control of an industrial installation, in particular

an installation in the raw materials industry, is transmitted from an evaluation center or development center to the industrial installation, in particular the installation in the raw materials industry, and is
5 installed and commissioned independently on the industrial installation.

In an advantageous refinement of the invention, the installed mobile program code generates further mobile
10 program codes in accordance with a predefined task, said program codes being transmitted within the industrial installation.

In a further advantageous refinement of the invention,
15 information is transmitted between the evaluation center or the development center and the industrial installation, in particular the installation in the raw materials industry, via ISDN, satellite or Internet.

20 In an advantageous refinement of the invention, the mobile program code is JAVA program code.

In an advantageous refinement of the invention, the mobile program code runs on hardware provided for the
25 open-loop or closed-loop control of the industrial installation, in particular the installation in the raw materials industry.

In a further advantageous refinement of the invention,
30 the installed mobile program code for the closed-loop and open-loop control of the industrial installation is designed to monitor the industrial installation. In this case, monitoring of an industrial installation, in particular an installation in the raw materials industry,

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is carried out by means of a mobile program code which monitors the industrial installation, in particular the

installation in the raw materials industry, automatically
for faults or special events, in the event of a fault or
a special event, the information needed to evaluate the
fault or the special event being transmitted by means of
5 the mobile program code or a further mobile program code
to

an evaluation center separated physically from the industrial installation, in particular the installation in the raw materials industry. In this case, special events are to be understood as violations of limiting values or trends or the occurrence of regular print-outs of particular significance. Special events can in addition be tolerance deviation of process data (strip profile faults temperature faults, and so on) or special features in the convergence behavior in the adaptation of models. In this way, much faster and more comprehensive evaluation of faults, limiting value violations and so on is possible. It is further of particular advantage to carry out the recognition of trends of looming faults by means of the information determined by the mobile program code. This permits, for example, preventative maintenance of a corresponding installation.

In an advantageous refinement of the invention, the mobile program code forms and dispatches new mobile program code, the new mobile program code monitoring parts of the industrial installation, in particular the installation in the raw materials industry, automatically for faults or special events, in the event of a fault or a special event, the information needed to evaluate the fault or the special event being transmitted directly to the evaluation center or, in particular for further transmission to the evaluation center, to another mobile program code.

Further advantages and details emerge from the following description of an exemplary embodiment.

The FIG shows, in an exemplary configuration, an industrial installation 30, illustrated schematically,

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with its control system and its actuators and sensors,

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without the actual process sequence. The industrial
installation 30 has an industrial Ethernet bus 9, which
provides a data connection between two identically or
differently configured automation devices 5 and 6, an
5 operating

computer 4 and a commissioning computer 1. The industrial Ethernet bus 9 is connected to a standard Ethernet bus 8 via a computer 7. An operating computer 2 and a central operating computer 3 are connected to the standard Ethernet bus 8. Via a bus system 23, which is designed as a Profibus, various actuators or sensors 12, 13, 14, 15 are provided with a data connection to the automation device 5. Furthermore, a decentralized peripheral 10 is connected to the automation device 6 via the bus system 23. Via a bus system 24, which is designed as a Profibus, various actuators or sensors 16, 17, 18, 19 are provided with a data connection to the automation device 6. Furthermore, a decentralized peripheral 11 is connected to the automation device 6 via the bus system 24. Via the decentralized peripheral 11, various actuators and sensors 20, 21, 22 can be driven or evaluated via the automation device 6. The operating computers 2, 3, 4, the automatic devices 5, 6, the decentralized peripherals 10, 11, the actuators or sensors 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and the bus systems 8, 9, 23, 24 serve the operation of the industrial installation.

Reference symbol 40 designates an evaluation center that is separated physically from the industrial installation 30 and is advantageously also used as a development center. In an exemplary configuration, the evaluation center 40 has a computer system having, for example, a plurality of computers 41 and 42 coupled via a bus system 43. A communication link 50 provides a data connection between the industrial plant 30 and the evaluation center 40. In this case, this does not have to be a so-called dedicated line. In an exemplary configuration, the industrial plant 30 and the evaluation center 40 have a data connection to each other via the commissioning

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computer 1 on the side of the industrial installation 30
and the computer 41 on

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the side of the evaluation center 40. In order to monitor the industrial installation 30, mobile program code is transmitted from the computer 41 to the commissioning

computer 1. By means of the transmitted mobile program code, which runs on the commissioning computer 1, the other components 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 are monitored for faults or special events, such as limiting value violations. For this purpose, the mobile program code operating on the commissioning computer 1 automatically generates further mobile program codes, which are transmitted from the commissioning computer 1 to the automation devices 5, 6, the decentralized peripherals 10 and 11 and to the actuators or sensors 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and, if appropriate, to the operating computers 2, 3, 4. If one of these transmitted mobile program codes detects a fault or the special event, then this mobile program code transmits a communication relating to this fault or the special event and also all the information needed for evaluation to the mobile program code installed on the commissioning computer 1, which sets up the communications link 50 to the computer 41 and then transmits this information to the computer 41. The transmitted information can, for example, be log files which are generated on the basis of warning and error messages. Furthermore, it may be tolerance deviations of process data (for example strip profile faults temperature faults and so on), adaptation coefficients or coefficients from neural networks and the states of computers (for example memories, hard disk capacity, CPU loading and so on). In addition, provision can be made to register the frequency of warning messages and to evaluate it statistically.

The mobile program code is particularly advantageously implemented in JAVA. This is preferably carried out by following the Aglet concept, as disclosed by D.B. Lange,

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M. Oshima: "Programming and Developing JAVA Mobile Agents
with Aglets", Edison-Wesley, 1998.

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The invention is used particularly advantageously in rolling mills.

Patent claims

1. A method of installing a mobile program code for the closed-loop or open-loop control of an industrial installation, in particular an installation in the raw materials industry, the mobile program code being transmitted from an evaluation center (40) or development center to the industrial installation, in particular the installation (30) in the raw materials industry, and being installed and commissioned independently on the industrial installation (30).
2. The method as claimed in claim 1, characterized in that the mobile program code on the industrial installation (30) generates further mobile program codes in accordance with a predefined task, and these further mobile program codes are transmitted within the industrial installation (30).
3. A method as claimed in claim 1, characterized in that the mobile program codes are transmitted between the evaluation center (40) or the development center and the industrial installation (30) via ISDN, satellite or Internet.
4. The method as claimed in claim 1 or 2, characterized in that the mobile program code is JAVA program code.
5. The method as claimed in claim 4, characterized in that the mobile program code runs on hardware provided for the open-loop or closed-loop control of the industrial installation (30).

6. The method as claimed in claim 1 or 2, characterized in that

the installed mobile program code for the closed-loop or open-loop control of the industrial installation (30) is designed to monitor the industrial installation (30).

5

7. The method as claimed in claim 6, characterized in that the mobile program code monitors the industrial installation (30) independently for faults or special events, in the event of a fault or a special event the information needed to evaluate the fault or the special event being transmitted to the evaluation center (40) by means of the mobile program code or a further mobile program code.
- 10